Marvell's
Summary Judgment Motion
Re: Lack of Written Description
December 14, 2011

United States District Court
Western District of Pennsylvania
Civ. No. 2:09-cv-00290-NBF

Marvell Technology Group, Ltd.
Marvell Semiconductor, Inc.

Overview

1) Legal Framework
2) Prior Construction of “Function” & Fn. 10
3) Group 1 Claims
4) CMU’s Spec: Lack of Written Description

- ► No written description of Eq. 13 as a “set” of BM “functions”
- ► No written description of a “selecting” step using Eq. 13
- ► CMU’s Claim Amendment introduced “new matter”

APPENDIX:

5) Consistency: Anticipation Based Worstell
6) Indefinite Claim Scope

Legal Framework for Summary Judgment Motion

1) Court has already determined the scope of the Group 1 Claims
2) If there were a trial, Jury would be "instructed" on the scope of the claims term as a matter of law:
   (a) "Function" is to be given its general English definition, namely, "a mathematical correspondence that assigns exactly one element of one set to each element of the same or another set"
   (b) Under this construction, "simply adding another variable into a function, does not operate to convert a single function into multiple functions"
   (c) "Selecting" means "to choose one from a set of more than one."

Legal Framework for Summary Judgment Motion

3) 35 U.S.C. § 112, ¶ 1:
   - "The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same…."
4) How is Eqn. 13 actually "described" in the spec?
   - Marvell: No written description ("with reasonable clarity") of Eq. 13 as a "set" of BM "functions" or of a "selecting" step using Eq. 13
   - "No reasonable fact finder could return a verdict" for CMU on Marvell's written description defense. *Atl. Research Mktg. Sys., Inc. v. Troy*, 659 F.3d 1345, 1353 (Fed. Cir. 2011).

Written Description Requirement (§ 112, ¶ 1):

- “[T]he applicant must convey with **reasonable clarity** to those skilled in the art that, as of the filing date sought, he or she was in **possession of the invention**, and **demonstrate[s] that by disclosure in the specification of the patent.**”

  Carnegie Mellon Univ. v. Hoffman La Roche Inc., 541 F.3d 1115, 1122 (Fed. Cir. 2008).

The "Written" Description Requirement

- Focuses on what is "written" and not what may be "obvious"
  - "[A]n applicant complies with the written description requirement 'by **describing** the invention, **with all its claimed limitations**, **not that which makes it obvious**,' and by using 'such descriptive means as words, structures, figures, diagrams, formulas, etc., that set forth the claimed invention.'"

    Regents of the Univ. of California v. Eli Lilly, 119 F.3d 1559, 1566 (Fed. Cir. 1997)
  - "The question is not whether a claimed invention is an **obvious** variant of that which is disclosed in the specification. Rather, [the subject specification] itself **must describe an invention**, and do **so in sufficient detail** that one skilled in the art can clearly conclude that the inventor invented the claimed invention as of the filing date sought."

    Lockwood v. Am. Airlines, 107 F.3d 1565, 1572 (Fed. Cir 1997)

"Written" Description: Invalid "On Its Face"

- Because the inquiry is focused on what is "written" and not what may be "obvious," courts have routinely granted summary judgment where the specification was insufficient "on its face."

Patent Case Management Judicial Guide

Cir. 2005) (indefiniteness standard). While the issue of written description is a question of fact, a patent can nonetheless be held invalid "on its face" for lack of adequate written description. *Univ. of Rochester v. G.D. Searle & Co., Inc.*, 358 F.3d 916, 927 (Fed. Cir. 2004) (describing written description standard and listing cases where a patent was held invalid "on its face" under this standard). Importantly, enablement, indefiniteness, and written description are issues that often turn on the meaning of a single claim limitation that appears throughout the claims in dispute. For example, modifying the *Planet Bingo* facts slightly, the de-

Patent Case Management Judicial Guide at p. 6-7 (2009)

Written Description Guards Against New Matter

- "One of the roles of the written description requirement is to ensure that patent claims are not amended to claim subject matter different from what was described in the patent application on the date of its filing."

  ICN Photonics, Ltd. v. Cynosure, Inc. 73 Fed. Appx. 4225, 429 (Fed. Cir. 2003)

Court’s Prior Construction of “Function”

Court's Claim Construction for "Function" & Fn. 10

- "Adopted" the general-English definition:

Marvell did not advance a construction of the word "function," other than to say that it should be given its ordinary meaning. (Docket No. 301 at 25). On the other hand, according to CMU, a "function" is "a mathematical relation that uniquely associates members of a first set with members of a second set." (Docket No. 264 at 5). This is essentially the ordinary meaning of the word "function." *See* Merriam-Webster's Collegiate Dictionary, 507 (11th ed. 2007) (defining "function" as "a mathematical correspondence that assigns exactly one element of one set to each element of the same or another set"). Under this ordinary meaning, which the Court adopts for purposes of this motion since the parties seem to be in agreement, simply adding another variable into a function – here the target value – does not operate to convert that single function into multiple functions.[10] Therefore, variation of the target value does not render Equation 20 of the Seagate Patent a "set" of functions.

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[10] The Court notes that this reasoning would seem to render the CMU claims invalid under 35 U.S.C. § 112 ¶ 1. It appears that this definition would result in Equation 13 of the '839 patent also being considered a *single* function, such that the patent does not teach a set of functions from which one function may be selected. However, as this argument would arise under § 112, and the instant motion is brought under § 102, the Court will not decide the point at this juncture.

Dkt. No. 306 at 16-17, n.10.

Group 1 Claims

Group I: ’839 Patent Claim 1 (As-Issued)

1. A method of determining branch metric values for branches of a trellis for a Viterbi-like detector, comprising:

[1] selecting a branch metric function for each of the branches at a certain time index; and

[2] applying each of said selected functions to a plurality of signal samples to determine the metric value corresponding to the branch for which the applied branch metric function was selected,

wherein each sample corresponds to a different sampling time instant.

Uses multiple BM “functions.”

Written Description Analysis

Footnote 10 Issue: The "Missing" Description

Part 1

- Does the specification "describe" Eqn. 13 as a "set" of "branch metric functions" with reasonable clarity?
  - One answer: No
- CMU's spec:
  - Explicitly describes Eqn. 13 as a "metric" in the singular and not the plural. Col. 6:66-7:4; 6:36
  - Spec and Figures consistently refer to the Eqn. 13 "metric" in the singular and not the plural

Part 2

- Does the Spec describe the "selecting" step?

Eqn. 13 Is Described As A ***Single*** "Metric"

- Eqn. 13 is explicitly referred to as a "metric" in the singular and not as a "set" of metrics or functions

> With this notation, the general correlation-sensitive metric is:
>
> $$M_i = \log det \frac{C_i}{det \ c_i} + \underline{N}_i^T C_i^{-1} \underline{N}_i - \underline{n}_i^T c_i^{-1} \underline{n}_i \qquad (13)$$

- Eqn. 13 is expressed as a single mathematical "correspondence"
  - ➢ Based on the Court's construction, Eqn. 13 is a single "function"

Per SJ Opin., Adding A "Variable" Does Not Change Result

- Adding "variables" to a branch metric function "does not operate to convert it into multiple functions"
  - Target value variables (m_i, m_{i+1}, m_{i+L}) in:
    - $\underline{N}_i = [(r_i - m_i)\ (r_{i+1} - m_{i+1})\ .\ .\ .\ (r_{i+L} - m_{i+L})]^T$
  - Noise covariance variables C_i:

$$\hat{C}(\ominus, +, -) = \begin{bmatrix} 0.5 & -0.2 \\ -0.2 & 0.8 \end{bmatrix} \qquad (24)$$

'839 Patent 10:56-60

With this notation, the general correlation-sensitive metric is:

$$M_i = \log det \frac{C_i}{det\ c_i} + \underline{N}_i^T C_i^{-1} \underline{N}_i - \underline{n}_i^T c_i^{-1} \underline{n}_i \qquad (13)$$

'839 Patent 6:66-7:4

The Specification Describes A *Single* CSBM Function

- Cols. 6-7 describe a single "correlation-sensitive" branch metric and not a set of different metrics or functions

Correlation-sensitive branch metric. In the most general case, the correlation length is L>0. The leading and trailing ISI lengths are K_l and K_t, respectively. The noise is now considered to be both correlated and signal-dependent. Joint

'839 Patent 6:36-39

* * *

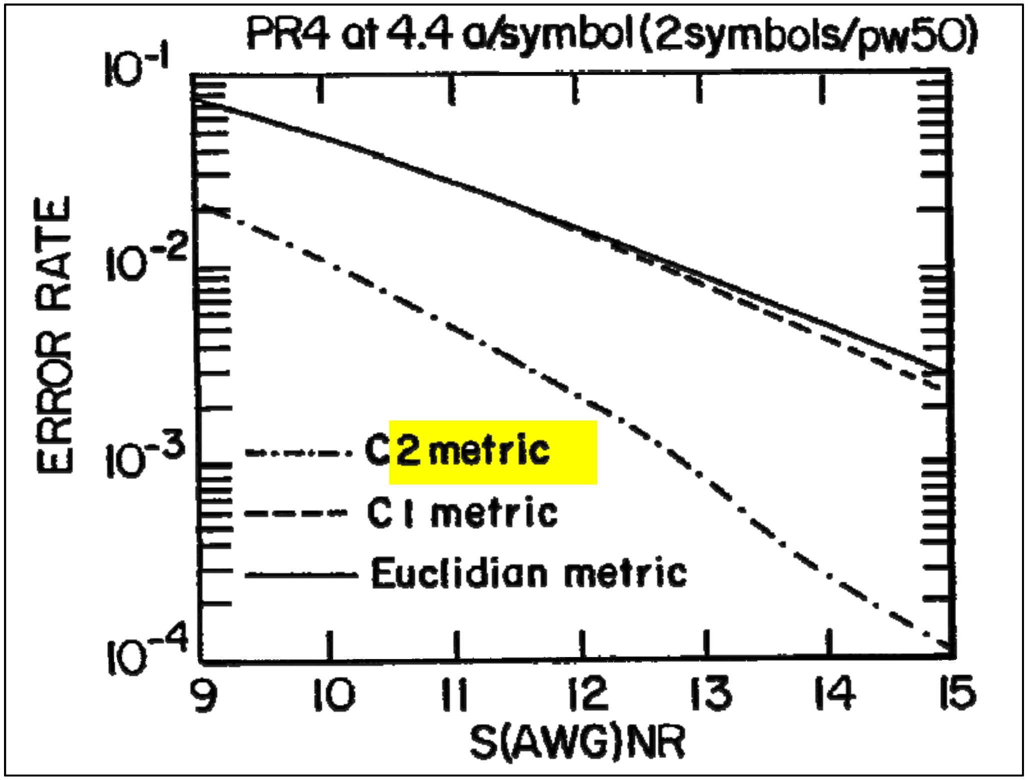
With this notation, the general correlation-sensitive metric is:

$$M_i = \log det \frac{C_i}{det\ c_i} + \underline{N}_i^T C_i^{-1} \underline{N}_i - \underline{n}_i^T c_i^{-1} \underline{n}_i \qquad (13)$$

'839 Patent 6:66-7:3

Consistent Use of Singular "Metric" Throughout Spec

- Throughout the spec, the "correlation-sensitive" branch metric Eqn. 13 is referred to as a "metric" in the singular – independent of changing signal to noise values



Noise Decreasing Relative to Signal

The "correlation-sensitive metric (13), named the C2 metric for short" (col. 12:2-3)

Figure 7, '839 patent

Spec Consistently Refers to the Eqn. 13 Metric in the Singular

- Spec is consistent across all Figures describing the “correlation-sensitive” branch metric (Eqn. 13)

FIG. 8

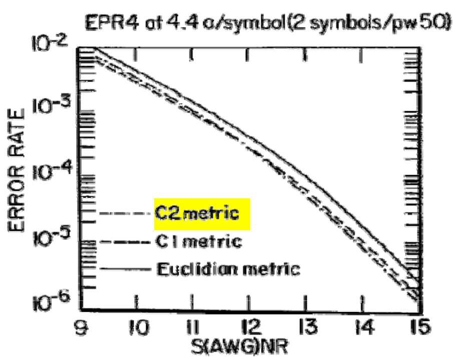


FIG. 10

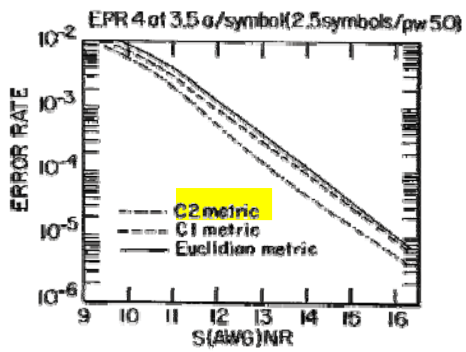


FIG. 12

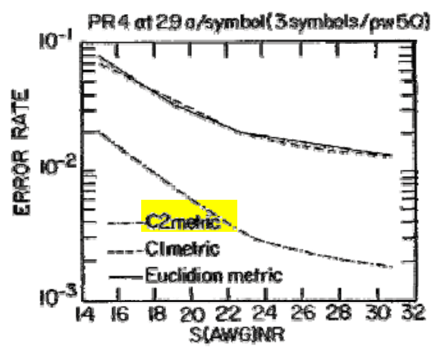


FIG. 9

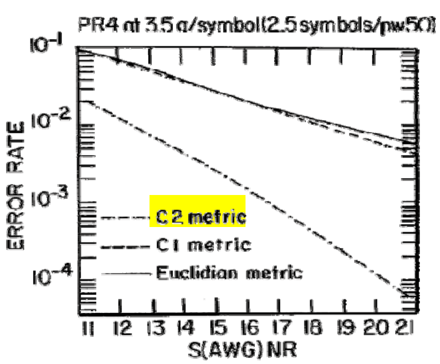


FIG. 11

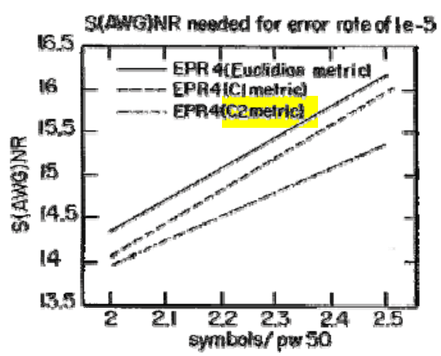
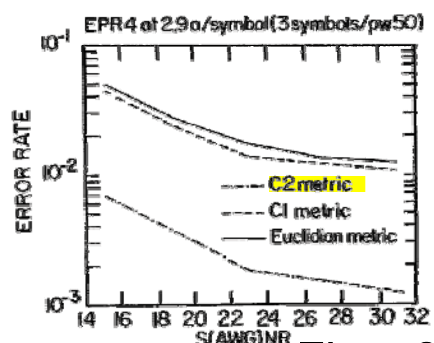


FIG. 13



Figs. 8-13, ‘839 patent

Written Description Guards Against New Matter

- "One of the roles of the written description requirement is to ensure that patent claims are not amended to claim subject matter different from what was described in the patent application on the date of its filing."

    ICN Photonics, Ltd. v. Cynosure, Inc. 73 Fed. Appx. 4225, 429 (Fed. Cir. 2003)

Prosecution History Confirms New Matter Was Added 3 Years Too Late

GROUP 2 CLAIMS | **GROUP 1 CLAIMS**

May 9, 1997

New Claims:
April 3, 1998

New Matter:
June 12, 2000

1997 | **1998** | **1999** | **2000**

CMU files Provisional Appln.:
(1)Includes Group 2 Claims only; and
(2)No mention of BM "function" or the verbs "select" or "choose"

CMU files '839 Patent Appln.:
(1)Adds Group 1 Claims referring to a BM "function" for the 1st time;
(2)Description of Eqn. 13 not altered; and
(3)Claims describe a single BM "function" to determine multiple BM "values"

(1) Group 1 Claims amended after being rejected over Fitzpatrick;
(2) Amendment requires multiple BM "functions" to determine multiple BM values;
(3) Written description of Eqn. 13 not altered.

Prosecution History of the Group 1 Claims

Original Claim 1 ('839 Patent) used a single BM function:

What is claimed is:

1. A method of determining branch metric values for branches of a trellis for a Virterbi-like detector, comprising:

selecting a branch metric function for each of the branches at a certain time index; and

applying said selected function to a plurality of time variant signal samples to determine the metric values.

Dkt. No. 318-8 at 28.

- Two Indisputable Conclusions:
  (1) The Applying Step required **one** BM function to be used to determine multiple metric values.
  (2) The only way that is possible is if Eqn. 13 is a "single" function

$$M_i = \log det \frac{C_i}{det\ c_i} + \underline{N}_i^T C_i^{-1} \underline{N}_i - \underline{n}_i^T c_i^{-1} \underline{n}_i$$

Amendment Added New Matter

Claim 1 was amended to use multiple BM functions:

1. (Amended) A method of determining branch metric values for branches of a trellis for a Virterbi-like detector, comprising:

selecting a branch metric function for each of the branches at a certain time index; and

applying each of said selected [function] functions to a plurality of [time variant] signal samples to determine the metric [values] value corresponding to the branch for which the applied branch metric function was selected, wherein each sample corresponds to a different sampling time instant.

Dkt. No. 318-10 at 3.

- Applying Step expanded:
  - (1) [Original]: one BM function across branches
  - (2) Amended: multiple BM functions across branches

Group I: '839 Patent Claim 1

1. A **method of determining branch metric values** for branches of a trellis for a Viterbi-like detector, comprising:

[1] selecting a branch metric function for each of the branches at a certain time index; and

values time variant function

[2] applying ~~each of~~ said selected ~~functions~~ to a plurality of signal samples to determine the metric ~~value corresponding to the branch for which the applied branch metric function was selected,~~

~~wherein each sample corresponds to a different sampling time instant~~.

a single

Uses ~~multiple~~ BM "function~~s~~."

CMU Does Not Raise Genuine Issue of Material Fact

- CMU does not respond to ***Marvell's*** Motion based on general English construction

1. CMU ***rewrites*** Motion by changing the claim construction using a hyper-technical mathematical construction
   - Conflicts with prior SJ Opinion
   - Conflicts with Markman Opinion
2. Irrespective of how "function" is construed, CMU uses the wrong legal standard:
   - The focus must be on how Eqn. 13 is "described"
   - **Not**: Whether the claimed subject matter would be obvious to derive from Eqn. 13 or from an "extrapolation" of Eqn. 13

Presumptuous CMU Re-Litigates Claim Construction

- CMU's Opp presumes Court has revised prior claim construction rulings
  - Issue: Whether "function" refers to a general English meaning or to a hyper-technical mathematical construction?
- Adopting CMU's current construction would result in inconsistencies with:
  - The Court's prior SJ Opinion re: Worstell
  - The Court's prior Markman rulings

General English vs. Hyper-Technical Math?

- During Markman, the Court already construed the "correlation-sensitive branch metrics" phrase using "general English":

> **A. Correlation;**
> **Correlation-sensitive branch metrics;**
> **Correlation-sensitive metric computation update circuit**
>
> The principal dispute between the parties for the "correlation" terms is whether "correlation" refers to a general English meaning of relatedness or if it refers to a specific statistical usage and calculation as found in technical dictionaries.

Dkt. No. 175, Markman Op. at 7

> In considering all of the intrinsic evidence and extrinsic sources provided by the parties, the PHOSITA would find that "correlation," as used throughout the patent refers to the general English meaning. Marvell argues that CMU's construction comes from an amalgam of sources.

Id. at 15

CMU's New Arguments Re: "Function"

- Under CMU's new hyper-technical construction, a "function" is defined by "four different symbol types": arguments, outputs, constants and parameters.
- McLaughlin 2nd Decl. (3/2011)
  - Previously spent over 20 pgs. discussing "functions" without any references whatsoever to distinguishing "parameters" from "constants" (¶¶ 12-33)
- Strang cites only a single reference where his so-called "parameter" is defined (¶ 21) – Wikipedia
  - That definition is provided in connection with Wikipedia's definition of a "parameter" (http://en.wikipedia.org/wiki/Parameter) not the definition of "function" (http://en.wikipedia.org/wiki/Function_(mathematics))

CMU Tries To Have It Both Ways

- Under Strang's definition, a "single" function is also a "set" of functions:

> Parameters are not constants, because parameters can change; that is their purpose. A change in the parameter causes the function to change. The "parameters" help define the structure of the "machine" or "rule" that is applied to the inputs. Using our base example of f(x) = 2x and changing the value "2" to "A" we end up with the function f(x) = Ax. Here "A" is a *parameter* of the function and for each value of "A", a different function is identified. Thus, for example, where A = 2, the resulting function for that value of A is f(x) = 2x, and each input value of x (1 through 100) is multiplied by 2. If the value of A is changed to 3, the resulting function is f(x) = 3x, and the same set of inputs (1 through 100) is now multiplied by 3 – resulting in a different set of outputs. These two expressions are two different functions.

Strang Decl. at ¶ 11

- Under CMU's reasoning, Worstell's "Further Modified" Branch Metric is also a "set" of functions. See Proakis Decl. at ¶¶ 24-37.

McLaughlin Uses the Wrong Legal Standard

- Prof. McLaughlin claims:

> **THE CMU PATENT EXPRESSLY DESCRIBE THAT EQUATION 13 IS A "SET" OF FUNCTIONS**
>
> 44. Prof. Proakis and Marvell assert that equation 13 is a single branch metric

McLaughlin 3rd Decl. at ¶ 44, Section Title

- Spends six (6) pages discussing cols. 4, 5 + 6 but never ONCE points to language he asserts "expressly describes" Eqn. 13 as a "set" of functions. *Id*. at ¶¶ 44-51.
  - Performs an improper "obviousness" analysis
  - Dismisses the two (2) places in the spec that is dispositive of the issue:

Column 6: lines 36 & 66

The ’839 Patent: Columns 4, 5 and 6

4

the read-back waveform, sampled at the rate of one sample per symbol interval.

When the written sequence of symbols a_i, i=1, . . . , N, is read, the readback waveform is passed through a pulse-shaping equalizer and sampled one sample per symbol, resulting in the sequence of samples r_i, i=1, . . . , N. Due to the noise in the system, the samples r_i are realizations of random variables. The maximum likelihood detector determines the sequence of symbols a_i that has been written, by maximizing the likelihood function, i.e.:

$$\{\hat{a}_1, \dots, \hat{a}_N\} = \arg\left[\max_{\text{all } a_i} f(r_1, \dots, r_N \mid a_1, \dots, a_N)\right] \tag{1}$$

In (1), the likelihood function f (r_1, . . . , r_N|a_1, . . . , a_N) is the joint probability density function (pdf) of the signal samples r_1, . . . , r_N, conditioned on the written symbols a_1, . . . , a_N. The maximization in (1) is done over all possible combinations of symbols in the sequence {a_1, . . . , a_N}.

Due to the signal dependent nature of media noise in magnetic recording, the functional form of joint conditional pdf f (r_1, . . . , r_N|a_1, . . . , a_N) in (1) is different for different symbol sequences a_1, . . . , a_N. Rather than making this distinction with more complex but cluttered notation, the notation is kept to a minimum by using simply the same symbol f to denote these different functions.

By Bayes rule, the joint conditional pdf (likelihood function) is factored into a product of conditional pdfs:

$$f(r_1, \dots, r_N \mid a_1, \dots, a_N) = \prod_{i=1}^{N} f(r_i \mid r_{i+1}, \dots, r_N, a_1, \dots, a_N). \tag{2}$$

To proceed and obtain more concrete results, the nature of the noise and of the intersymbol interference in magnetic recording is exploited.

Finite correlation length. The conditional pdfs in Equation (2) are assumed to be independent of future samples after some length L≧0. L is the correlation length of the noise. This independence leads to:

$$f(r_i|r_{i+1}, \dots, r_N, a_1, \dots, a_N) = f(r_i|r_{i+1}, \dots, r_{i+L}, a_1, \dots, a_N). \tag{3}$$

Finite intersymbol interference. The conditional pdf is assumed to be independent of symbols that are not in the K-neighborhood of r_i, . . . , r_{i+L}. The value of K≧1 is determined by the length of the intersymbol interference (ISI). For example, for PR4, K=2, while for EPR4, K=3. K_l≧0 is defined as the length of the leading (anticausal) ISI and K_t≧0 is defined as the length of the trailing (causal) ISI, such that K=K_l+K_t+1. With this notation the conditional pdf in (3) can be written as:

$$f(r_i|r_{i+1}, \dots, r_{i+L}, a_1, \dots, a_N) = f(r_i|r_{i+1}, \dots r_{i+L}, a_{i-K_l}, \dots, a_{i+L+K_t}). \tag{4}$$

Substituting (4) into (2) and applying Bayes rule, the factored form of the likelihood function (conditional pdf) is obtained:

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$$\begin{aligned} f(r_1, \dots, r_N \mid a_1, \dots, a_N) &= \prod_{i=1}^{N} f(r_i \mid r_{i+1}, \dots, r_N, a_1, \dots, a_N) \\ &= \prod_{i=1}^{N} \frac{f(r_i, r_{i+1}, \dots, r_{i+L} \mid a_{i-K_l}, \dots, a_{i+L+K_t})}{f(r_{i+1}, \dots, r_{i+L} \mid a_{i-K_l}, \dots, a_{i+L+K_t})}. \end{aligned} \tag{5}$$

The factored form of equation (5) is suitable for applying Viterbi-like dynamic programming detection techniques. Equation (5) assumes anticausal factorization, i.e., it is derived by taking into account the effect of the samples r_{i+1}, . . . , r_{i+L}, on r_i. If only the causal effects are taken into account, the causal equivalent of (5) can be derived as f (r_1, . . . r_N|a_1, . . . , a_N)=

$$\prod_{i=1}^{N} \frac{f(r_i, r_{i+1}, \dots, r_{i+L} \mid a_{i-K_l}, \dots, a_{i+L+K_t})}{f(r_{i+1}, \dots, r_{i+L-1} \mid a_{i-K_l}, \dots, a_{i+L+K_t})}$$

The causal and anticausal factorization could be combined to find the geometric mean of the two to form a causal-anticausal factorization. Since this only complicates derivations and does not provide further insight, only the anticausal Equation (5) is considered.

Maximizing the likelihood function in (5) is equivalent to minimizing its negative logarithm. Thus, the maximum likelihood detector is now:

$$\begin{aligned} \{\hat{a}_1, \dots, \hat{a}_N\} &= \arg\left[\min_{\text{all } a_i} \log \prod_{i=1}^{N} \frac{f(r_{i+1}, \dots, r_{i+L} \mid a_{i-K_l}, \dots, a_{i+L+K_t})}{f(r_i, r_{i+1}, \dots, r_{i+L} \mid a_{i-K_l}, \dots, a_{i+L+K_t})}\right] \\ &= \arg\left[\min_{\text{all } a_i} \sum_{i=1}^{N} \log \frac{f(r_{i+1}, \dots, r_{i+L} \mid a_{i-K_l}, \dots, a_{i+L+K_t})}{f(r_i, r_{i+1}, \dots, r_{i+L} \mid a_{i-K_l}, \dots, a_{i+L+K_t})}\right] \\ &= \arg\left[\min_{\text{all } a_i} \sum_{i=1}^{N} M_i(r_i, r_{i+1}, \dots, r_{i+L}, a_{i-K_l}, \dots, a_{i+L+K_t})\right] \end{aligned} \tag{6}$$

M_i represents the branch metric of the trellis/tree in the Viterbi-like algorithm. The metric is a function of the observed samples r_i, r_{i+1}, . . . , r_{i+L}. It is also dependent on the postulated sequence of written symbols a_i−K_l, . . . , a_i+L+K_t, which ensures the signal-dependence of the detector. As a consequence, the branch metrics for every branch in the tree/trellis is based on its corresponding signal/noise statistics.

Specific expressions for the branch metrics that result under different assumptions on the noise statistics are next considered.

Euclidian branch metric. In the simplest case, the noise samples are realizations of independent identically distributed Gaussian random variables with zero mean and variance σ^2. This is a white Gaussian noise assumption. This implies that the correlation distance is L=0 and that the noise pdf s have the same form for all noise samples. The total ISI length is assumed to be K=K_l+K_t+1, where K_l and K_t are the leading and trailing ISI lengths, respectively. The conditional signal pdfs are factored as

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$$\frac{f(r_{i+1}, \dots, r_{i+L} \mid a_{i-K_l}, \dots, a_{i+L+K_t})}{f(r_i, r_{i+1}, \dots, r_{i+L} \mid a_{i-K_l}, \dots, a_{i+L+K_t})} = \sqrt{2\pi\sigma^2} \exp\left[\frac{(r_i - m_i)^2}{2\sigma^2}\right] \tag{7}$$

Here the mean signal m_i is dependent on the written sequence of symbols. For example, for a PR4 channel, m_i ∈{−1,0,1}. The branch/tree metric is then the conventional Euclidian distance metric:

$$M_i = N_i^2 = (r_i - m_i)^2 \tag{8}$$

Variance dependent branch metric. It is again assumed that the noise samples are samples of independent Gaussian variables, but that their variance depends on the written sequence of symbols. The noise correlation length is still L=0, but the variance of the noise samples is no longer constant for all samples. The variance is σ^{2i}, where the index i denotes the dependence on the written symbol sequence. As for the Euclidian metric, it is assumed that the total ISI length is K=K_l+K_t+1. The conditional signal pdf is factored to give:

$$\frac{f(r_{i+1}, \dots, r_{i+L} \mid a_{i-K_l}, \dots, a_{i+L+K_t})}{f(r_i, r_{i+1}, \dots, r_{i+L} \mid a_{i-K_l}, \dots, a_{i+L+K_t})} = \sqrt{2\pi\sigma_i^2} \exp\left[\frac{(r_i - m_i)^2}{2\sigma_i^2}\right] \tag{9}$$

The corresponding branch metric is:

$$M_i = \log\sigma_i^2 + \frac{N_i^2}{\sigma_i^2} = \log\sigma_i^2 + \frac{(r_i - m_i)^2}{\sigma_i^2} \tag{10}$$

Correlation-sensitive branch metric. In the most general case, the correlation length is L>0. The leading and trailing ISI lengths are K_l and K_t, respectively. The noise is now considered to be both correlated and signal-dependent. Joint Gaussian noise pdfs are assumed. This assumption is well justified in magnetic recording because the experimental evidence shows that the dominant media noise modes have Gaussian-like histograms. The conditional pdfs do not factor out in this general case, so the general form for the pdf is:

$$\frac{f(r_{i+1}, \dots, r_{i+L} \mid a_{i-K_l}, \dots, a_{i+L+K_t})}{f(r_i, r_{i+1}, \dots, r_{i+L} \mid a_{i-K_l}, \dots, a_{i+L+K_t})} = \sqrt{\frac{(2\pi)^{L+1} \det C_i}{(2\pi)^L \det c_i}} \frac{\exp[\underline{N}_i^T C_i^{-1} \underline{N}_i]}{\exp[\underline{n}_i^T c_i^{-1} \underline{n}_i]} \tag{11}$$

The (L+1)×(L+1) matrix C_i is the covariance matrix of the data samples r_i, r_{i+1}, . . . , r_{i+L}, when a sequence of symbols a_{i-Kl}, . . . a_{i+L+Kt} is written. The matrix c_i in the denominator of (11) is the L×L lower principal submatrix of C_i=[c_i]. The (L+1)-dimensional vector $\underline{N}_i$ is the vector of differences between the observed samples and their expected values when the sequence of symbols a_{i-Kl}, . . . , a_{i+L+Kt} is written, i.e.:

$$\underline{N}_i = [(r_i - m_i)(r_{i+1} - m_{i+1}) \dots (r_{i+L} - m_{i+L})]^T \tag{12}$$

The vector $\underline{n}_i$ collects the last L elements of $\underline{N}_i$, $\underline{n}_i$=[(r_{i+1}−m_{i+1}) . . . (r_{i+L}−m_{i+L})]^T.

With this notation, the general correlation-sensitive metric is:

Lockwood v. Am. Airlines, Inc., 107 F.3d 1563 (Fed. Cir. 1997)

"Lockwood argues that the district court erred by looking solely at the applications themselves. We do not agree. It is the disclosures of the applications that count. Entitlement to a filing date does not extend to subject matter which is not disclosed, but would be obvious over what is expressly disclosed. It extends only to that which is disclosed. While the meaning of terms, phrases, or diagrams in a disclosure is to be explained or interpreted from the vantage point of one skilled in the art, all the limitations must appear in the specification. The question is not whether a claimed invention is an obvious variant of that which is disclosed in the specification. Rather, a prior application itself must describe an invention, and do so in sufficient detail that one skilled in the art can clearly conclude that the inventor invented the claimed invention as of the filing date sought. *See Martin v. Mayer*, 823 F.2d 500, 504, 3 U.S.P.Q.2D (BNA) 1333, 1337 (Fed. Cir. 1987) (stating that it is 'not a question of whether one skilled in the art might be able to construct the patentee's device from the teachings of the disclosure . . . . Rather, it is a question whether the application necessarily discloses that particular device.') (quoting *Jepson v. Coleman*, 50 C.C.P.A. 1051, 314 F.2d 533, 536, 136 U.S.P.Q. (BNA) 647, 649-50 (CCPA 1963))."

Id. at 1571-72

Lockwood v. Am. Airlines, Inc. (continued)

"Lockwood argues that all that is necessary to satisfy the description requirement is to show that one is 'in possession' of the invention. Lockwood accurately states the test, see *Vas-Cath Inc. v. Mahurkar*, 935 F.2d 1555, 1563-64, 19 U.S.P.Q.2D (BNA) 1111, 1117 (Fed. Cir. 1991), but fails to state how it is satisfied. One shows that one is 'in possession' of the invention by describing the invention, with all its claimed limitations, not that which makes it obvious. *Id.* ('The applicant must also convey to those skilled in the art that, as of the filing date sought, he or she was in possession of the invention. The invention is, for purposes of the 'written description' inquiry, whatever is now claimed.') (emphasis in original). One does that by such descriptive means as words, structures, figures, diagrams, formulas, etc., that fully set forth the claimed invention. Although the exact terms need not be used *in haec verba*, see *Eiselstein v. Frank*, 52 F.3d 1035, 1038, 34 U.S.P.Q.2D (BNA) 1467, 1470 (Fed. Cir. 1995) ('The prior application need not describe the claimed subject matter in exactly the same terms as used in the claims . . . .'), the specification must contain an equivalent description of the claimed subject matter. A description which renders obvious the invention for which an earlier filing date is sought is not sufficient."

Id. at 1571-72

Court's Footnote 10

renders

results

[10] The Court notes that this reasoning ~~would seem to render~~ the CMU claims invalid under 35 U.S.C. § 112 ¶ 1. ~~It appears that~~ this definition ~~would result~~ in Equation 13 of the '839 patent also being considered a *single* function, such that the patent does not teach a set of functions from which one function may be selected. However, as this argument would arise under § 112, and the instant motion is brought under § 102, the Court will not decide the point at this juncture.

Dkt. No. 306 at 16-17, n.10.

Part 2

The "Missing" Selecting Step

The "Selecting" Step

1. A method of determining branch metric values for branches of a trellis for a Viterbi-like detector, comprising:

[1] selecting a branch metric function for each of the branches at a certain time index; and

[2] applying each of said selected functions to a plurality of signal samples to determine the metric value corresponding to the branch for which the applied branch metric function was selected,

wherein each sample corresponds to a different sampling time instant.

'839 patent, claim 1

- Under the parties' agreed-to construction, "selecting" means "to choose one from a set of more than one."

Dkt. 120-1 at 3.

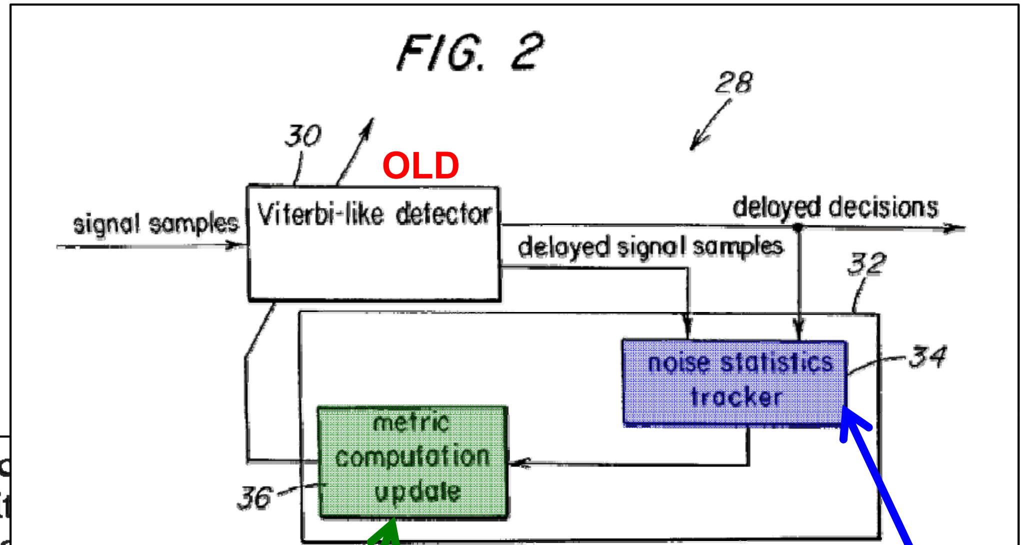
No Description of a "Selecting" Step

- There can be no disclosure of the "Selecting Step" when there is only one CSBM function described in the spec to choose from. See prior slides.
- No "written" words
  - Spec never once refers to "select" or "selecting," or any equivalent words ("choose"/"choosing")
- No Figures or Diagrams
  - As illustrated in the spec, the FIGURES do not provide the necessary description

Figure 2: Detector Circuit

No "Selecting" Circuit Described or Illustrated.

See Proakis Decl. at ¶ 55(b).



A block diagram of a CS-MLSD detector c shown in FIG. 2. The CS-MLSD detector circuit of the detector circuit 26 of FIG. 1. The detector circuit 28 has a feedback circuit 32 which feeds back into a Viterbi-like detector 30. The outputs of the detector 30 are decisions and delayed signal samples, which are used by the feedback circuit 32. A noise statistics tracker circuit 34 uses the delayed samples and detector decisions to update the noise statistics, i.e., to update the noise covariance matrices. A metric computation update circuit 36 uses the updated statistics to calculate the branch metrics needed in the Viterbi-like algorithm. The algorithm does not require replacing current detectors. It simply adds two new blocks in the feedback loop to adaptively estimate the branch metrics used in the Viterbi-like detector 30.

'839 Patent 3:29-44

Updates the noise covariance matrices

Calculates the branch metrics: [M_1, M_2 . . . M_8]

Fig. 3A: Spec Does Not Describe the "Selecting" Step

- Throughout the spec, there is no description of any hardware or design that performs a "selecting" step. Proakis Decl. at ¶ 55(a).

FIG. 3A illustrates a block diagram of a branch metric computation circuit 48 that computes the metric M_i for a branch of a trellis, as in Equation (13). Each branch of the trellis requires a circuit 48 to compute the metric M_i.

'839 patent at col. 7, lns. 10-13.

- Treats Target Values m_i and Noise Statistics σ_i^2 the same – as "inputs" to the BM Computation Circuit.

FIG. 3A

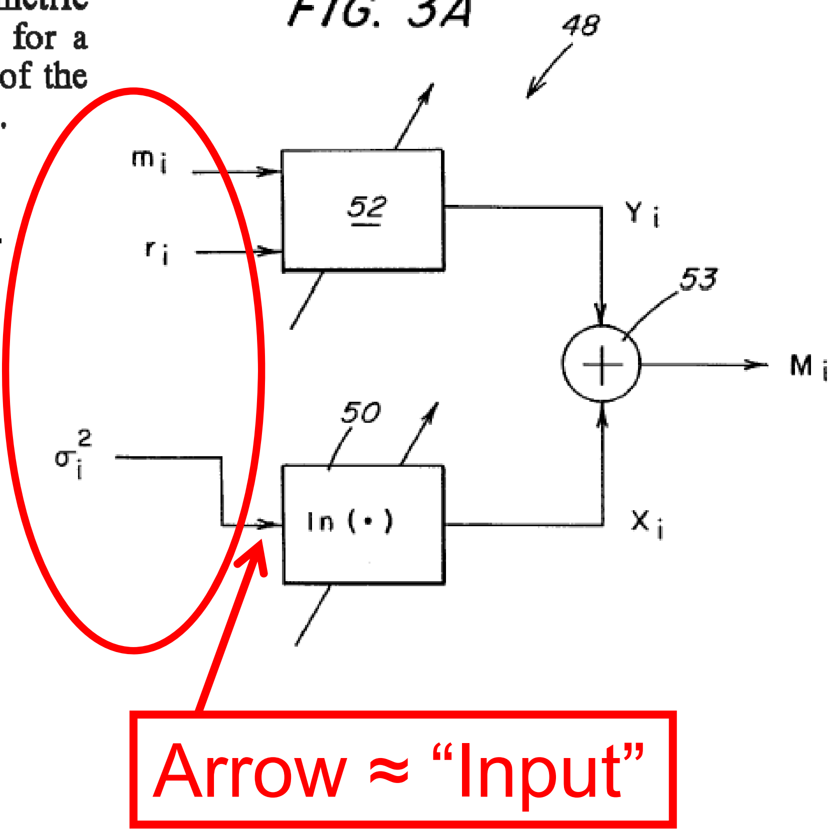
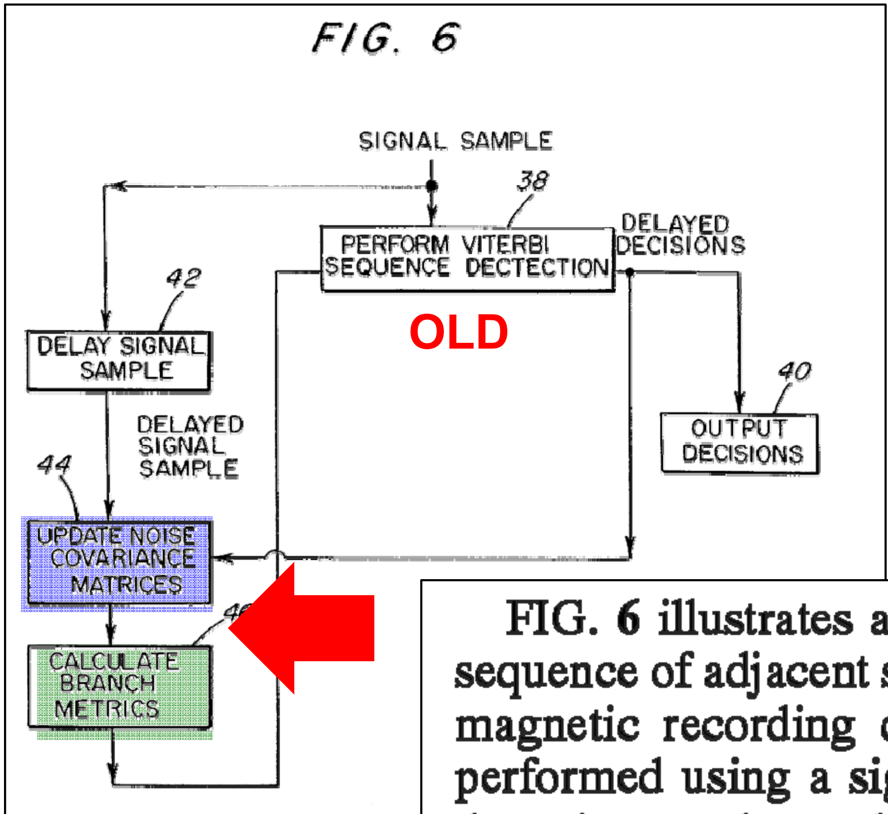


Figure 6: Flowchart of Detection Method



No "Selecting" Step Described or Illustrated. See Proakis Decl. at ¶ 55(b).

FIG. 6 illustrates a flowchart of a method of detecting a sequence of adjacent signal samples stored on a high density magnetic recording device. Viterbi sequence detection is performed using a signal sample at step **38**. The sequence detection produces decisions which are output at step **40**. The signal sample is delayed at step **42**. The past samples and detector decisions are used to update the noise statistics at step **44**. Branch metrics, which are used in the sequence detection step **38**, are calculated at step **46**.

'839 Patent 11:11-19

CMU's Reponse to Marvell's Selecting Step Argument

- No independent argument other than to assert that Eqn. 13 is a "set" of functions
- CMU (again) applies the wrong standard by focusing on what can be "extrapolated" from the disclosure:

> 65. Also, the CMU patents disclose to a person of ordinary skill how the selection of an exemplary branch metric function is made: for a symbol sequence (⊖, +, –) use the corresponding covariance matrix C(⊖, +, –). *See* '839 patent at col. 9:30-34; 10:54-11:10. Extrapolating from the example, a person of ordinary skill would understand that the selecting process works as follows. Identify the branch (⊖, +, –). Fetch the covariance matrix parameter addressed by the branch, this addressed covariance matrix is denoted by (⊖, +, –). Update the covariance matrix parameter addressed by the branch, if running an adaptive algorithm. Then use the parameter (⊖, +, –) in (13) every time the branch metric value is required for branch (⊖, +, –) in the subsequent usage of the detector. '839 patent at col. 11:1-10.

Nov. 15, 2011 McLaughlin Decl. at ¶ 65.

CMU's Reponse to Marvell's Selecting Step Argument

- No independent basis to other than to assert that Eqn. 13 is a "set" of functions
- CMU (again) applies the wrong standard by focusing on what can be "extrapolated" from the disclosure:

> 65. Also, the CMU patents disclose to a person of ordinary skill how the selection of an exemplary branch metric function is made: for (1) a symbol sequence (⊖, +, –) use the corresponding covariance matrix *C*(⊖, +, –). *See* '839 patent at col. 9:30-34; 10:54-11:10. Extrapolating from the example, a person of ordinary skill would understand that the selecting process works as follows. Identify (2) the branch (⊖, +, –). Fetch the covariance matrix parameter addressed by the branch, (3) this addressed covariance matrix is denoted by (⊖, +, –). Update the covariance matrix parameter addressed by the branch, if running an adaptive algorithm. Then use (4) the parameter (⊖, +, –) in (13) every time the branch metric value is required for branch (⊖, +, –) in the subsequent usage of the detector. '839 patent at col. 11:1-10.

Nov. 15, 2011 McLaughlin Decl. at ¶ 65.

- **Four (4) different names for (⊖, + , −): Gibberish**

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renders

results

[10] The Court notes that this reasoning ~~would seem to render~~ the CMU claims invalid under 35 U.S.C. § 112 ¶ 1. ~~It appears that~~ this definition ~~would result~~ in Equation 13 of the '839 patent also being considered a *single* function, such that the patent does not teach a set of functions from which one function may be selected. ~~However~~, as this argument ~~would arise under § 112~~, ~~and the instant motion~~ is brought under ~~§ 102~~, the Court ~~will not~~ decide the point at this juncture.

§ 112, ¶ 1

can

Dkt. No. 306 at 16-17, n.10.

APPENDIX:

Anticipation by Worstell

Anticipation by Worstell (§ 102)

- If CMU Eqn. 13 is used to practice the Group 1 Claims, then Worstell does as well.
- The Worstell and CMU patents each take "correlated" noise and "signal dependent" noise into account by providing a ***modified*** branch metric for use in an otherwise "conventional" Viterbi detector
- Variables used in both branch metrics
  - Present Signal Sample
  - Present Target Values
  - Prior Historical Noise Terms
  - Noise Statistics

Worstell's Modified Metric to Account for Transition (Media) Noise (Col. 10:48-11:2)

US 6,282,251 B1

9

If the contribution to the apparent noise from future samples is also ignored, then the formula given in Equation 12 simplifies to:

10

22 is a 15 tap FIR filter with tap weights selected to minimize misequalization error. FIG. 6 shows that many of the elements of the autocorrelation sequence are very small

The modified metric used in accordance with the present invention can be further modified to take into account transition noise as well. If it is assumed that the standard deviation of the noise component of each sample is greater where there is a transition in the signal written to the disc than where there is no transition, then each branch metric can be modified by multiplying the metrics which correspond to transitions by a fraction which depends on the transition noise standard deviation. Implementing this in a fairly straightforward way would require 8 multipliers, one for each "one" branch leading to each state in the appropriate trellis diagram. As with the presently modified metric, one of

modified Viterbi detector 24. However, FIG. 6 is a plot of the autocorrelation delay against normalized autocorrelation for a PR4 code having a density equal to three. It is assumed that the noise at the input of FIR filter 22 is white, and FIR filter

One μm CMOS, written by Robert W. Hawley, Thu-ji Lin, and Henry Samueli and published in the IEEE Journal of Solid State Circuits, January 1995 —hereby fully incorporated by reference) can be used. Another implementation is

Worstell '251 10:48-59

Worstell's Modified Metric to Account for Transition (Media) Noise (Col. 10:48-11:2)

- As Prof. Proakis explains:

27. The Worstell patent refers to multiplying the metrics by a "fraction that depends on the transition noise standard deviation." Worstell patent at 10:48-56. Because the standard deviation of the transition noise ($\sigma_{b,nt}$) is simply the square root of the variance ($\sigma_{b,nt}^2$), the recited fraction in the branch metric equation can be expressed as "[$1/\sigma_{b,nt}^2$]".

28. Incorporating this definition into Equation 20, the Worstell patent discloses a "further modified" metric as follows:

$$B_{b,nt} = [X^2_{b,nt} - 2X_{b,nt} \sum X_{b,(n-i)t} W_i] \times [1/\sigma_{b,nt}^2]$$

where $B_{b,nt}$ is the branch metric for branch b at time nt;
$X_{b,nt}$ is the noise and equalization error at time nt for branch b;
W_i is the i^{th} tap weight of FIR filter **22**;
L is the number of tap weights beyond the center weight;
the sum $\sum$ is taken from i = 1 to i = L; and
$[1/\sigma_{b,nt}^2]$ is the referenced "fraction that depends on the transition noise standard deviation."

Proakis Decl., Dkt. No. 318-3, at ¶¶ 27-28.

Worstell is Indistinguishable

- Under a consistent treatment, Worstell's "Further Modified" Metric and CMU Eqn. 13 are indistinguishable in any relevant respects

Variable Type	CMU Equation 13	Worstell's "Further Modified" Metric
Present Signal Sample	r_i	y_{nt}
Present Target Values	m_i	$y_{b,nt}$
Prior (historical) Noise Terms	n_i	$X_{b,(n-1)t}$
Noise Statistics	C_i and c_i	$\sigma_{b,nt}$

CMU's Response to Marvell's "Indistinguishable" Argument

- Claims the "transition noise standard deviation" ($\sigma_{b,nt}$) is "constant"
- Tries to support that conclusion by pointing to the wrong branch metric embodiment:

This embodiment does not relate to Worstell's "Further Modified" Metric which takes "signal-dependent" noise into account.

Performance of modified Viterbi detector 22 was evaluated using a Matlab-callable program implementing the new branch metric. Using an encoded system with a density of 3, and an EPR4 target response with a 15-tap FIR filter, the following results were obtained:

number of sequences: 128400

number of bits in each sequence: 100

standard deviation of noise at input to FIR filter: 0.055

number of sequence errors for the modified Viterbi detector as a function of the number of weights used in the new metric set out in Equation 20 (including the center weight):

Weights: 1 2 3 4 8 101

Errors: 52 47 11 6 4 14

Worstell patent at col. 10:18-32 (emphasis added). Thus, the Worstell patent provides only a single, fixed value for the "standard deviation of the noise," not a different value for each branch of the trellis at a given time index thereof. *See also* Worstell patent at col. 6:9-10 (introducing

McLaughlin Decl., Dkt. No. 318-3, at ¶ 35.

Indefiniteness

Indefinite Claim Scope (§ 112, ¶ 2)

- Group 1 Claims are invalid § 112, ¶ 2.
- The "selecting" step of the claims is indefinite
  - No reference in the Detailed Description of the Invention to the terms BM "function," BM "functions," "select," "selecting," "choose," and "choosing."
- The claims are insolubly ambiguous, as also evidenced by CMU's varying interpretations of the scope of these claims in this case.